

The Spatial Extent of Perennial Flow in Puget Lowland Streams

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This investigation analyzed physiographic control and the effects of land use on the spatial extent of perennial flow in stream basins in the Puget Lowland. Perennial streams define the spatial extent of aquatic habitat during summer in the Puget Lowland and their extent may be an important control on biological processes and conditions in streams. Stream networks in 59 basins throughout the Puget Lowland were mapped in August 1998 and 1999 during baseflow conditions. Reaches with surface flow were designated as perennial and those without surface flow were designated as ephemeral. The 59 basins included many different physiographic conditions for the region and spanned a range of land uses from rural to urban.

The spatial extent of perennial flow was analyzed in first-order streams (those with no tributaries) using the probability of perennial flow based on drainage area, and in higher order streams using the perennial stream density (the total length of streams with perennial flow in a basin divided by the drainage area of the basin). These two spatial measures of perennial flow were analyzed in conjunction with physiographic factors and land use in each basin. Five physiographic factors were hypothesized to influence the location and extent of perennial flow in a stream basin: (1) drainage area; (2) valley slope; (3) valley relief; (4) basin shape; and (5) surficial geology. The influence of land use was assessed by comparing the spatial extent of perennial flow to road density, which is the length of roads in a basin divided by the drainage area of the basin.

The analysis of first-order streams demonstrated a wide range of drainage areas for which streams can be ephemeral or perennial. There was a 5% probability of perennial flow where the drainage area was less than 0.1 km², a 50-percent probability where the drainage area was less than 1.2 km², and a 95-percent probability where the drainage area was less than 5 km². The probability of perennial flow did not vary between urban streams (road densities > 6 km/km²) and suburban streams (road densities < 6 km/km²) nor with the four physiographic factors other than drainage area.

The analysis of higher-order streams showed a linear relationship between perennial stream length and basin area except for smaller streams (drainage area less than approximately 10 km²). A linear relationship between perennial stream length and drainage area is equivalent to a constant perennial stream density, which had a mean value of 0.5 km/km² for the streams in this investigation. The influences of road density and topographic factors (valley slope, valley relief, basin shape) on the perennial stream density were not evident.

Surficial geology provided a reliable indicator of the extent of perennial flow in a stream network. The transition from ephemeral to perennial streams typically was found at the contact between glacial till and advance or recessional outwash deposits. Outwash aquifers provide the primary source of base flow in streams in the Puget Lowland region.

The extent of perennial flow in a stream network provides a measure of the aquatic habitat available during summer low-flow periods. Although urban development was not observed to influence the extent of perennial flow in the Puget Lowland, it is likely to influence the availability of aquatic habitat during spring and early summer when base flow is lower in urban streams. Moreover, changes in the extent of streams may occur during the initial clearing of forests, but were not demonstrated by this investigation.

Returning Watershed Functions to the Urban Landscape: Current Approaches Being Evaluated by the City of Seattle

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What stormwater management techniques are really available to cities that are fully urbanized? The effects of urbanization on creek ecosystems are well known. Common knowledge and practical research have pointed to the importance of riparian buffers, upper watershed detention, and both structural and behavioral Best Management Practices (BMPs). However, in a fully urbanized city such as Seattle many, if not the majority of these techniques are not feasible. Fully built-out conditions severely limit land available for riparian buffers or detention facilities. In addition, the high density of underground utilities (electricity, water, drainage, sewer, and telecommunications) can frustrate effort to install structural BMPs. Despite the inherent difficulties, Seattle Public Utilities (SPU) has embarked on several projects to evaluate stormwater management alternatives designed to mimic the physical, biological and chemical functions that are integral to a healthy creek ecosystem. One area of focus for stormwater management alternatives is the public right-of-way. This presentation will describe stormwater management techniques appropriate for an ultra-urban environment.